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Proximity-Based Overmatching Fires From the Total Force

by John H. Brand and Kenneth Yagrich

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14. ABSTRACT
Technology now permits control of fires from multiple, dissimilar platforms from many units across a wide area. Target allocation could be based on physical ability of a platform to engage a given target, subject to immediate mission and conditions. This would be based on ballistics, proximity, and terrain, regardless of unit affiliation. These platforms could belong to many units of differing types in different chains of command. The result would be an overwhelming level of fire from many small entities against larger ones. The implementation and advantages and disadvantages of such a scheme are discussed.

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1. Introduction—Past and Future Doctrine

About thirty years ago, one of the authors was taught the use of tank guns as artillery. This was actually done at times in WWII and Korea, but as the tempo of combat accelerated it became untenable, due to the time requirement to survey in a tank for indirect fire and the lack of available tanks. Armor was needed for the direct-fire battle, and the technique fell into disuse. Present technology can avoid the unacceptable time losses and give the necessary precision in location and orientation to allow use of direct-fire assets in an indirect-fire role. It is now time to reconsider the practical aspects and benefits of using all fire assets against targets regardless of their nominal, historical roles as direct or indirect fire.

2. The Proximity-Based Fires Concept

The combined combat power of many platforms can be overwhelming in certain situations, when not limited by the traditional restrictions imposed by the usual tactical roles or command relationships. A central fire control cell that can allocate or even direct and compute firing solutions for remote platforms can avoid pitfalls in conventional roles and command relationships. It should, however, be emphasized that the normal roles and command relationships remain; a platform optimized for direct fire will be commanded by a direct-fire unit commander, platforms optimized for indirect fire will be used in an artillery-like role most of the time. The capability is illustrated in the fictional scenario sketched later.

Cost and technical risk depend on the degree of control of remote assets by the central fire allocation and command node that is envisaged. The difference between what is sketched here as fiction and what is current practice is a matter of degree. That degree is based on the extent of control envisaged in the new scheme compared to classical control in a command relationship.[*]

There is a profound dynamic tension between the practical span of control for tactical units and the effective range of fire of those units.[†] Depending on what generation one has been raised in, a commander can expect to control about five to seven people directly. It is not clear how adding automation to the leadership equation will allow a greater span of control. The current

[*] It should be noted that this concept is not new in the science fiction literature. The best description has been given in David Drake's series of stories about a future interstellar armored cavalry regiment, "Hammer's Slammers." See, among others, *Hammer's Slammers*, Pocket Books: Reissue edition (May 1991) ASIN: 0671698672.

[†] Most tactical units were originally sized by what a man could control with his voice or some other means such as direct observation of signal flags. Effective range of weapons was about the range that could be observed by a commander co-located with the weapon, be it a battery of guns or a block of muskets. Now the units have enormously greater reach, but the unit organizations would not seem out of place in the nineteenth century. Presumably, the Future Combat System will change all that.

trend to “flatter” organizational profiles may be, one suspects, driven more by the desire for economy than anything else. Flatter organizations do presumably have shorter times to transfer orders through the (fewer) different echelons and that certainly can speed the command and control process. Whether it is practical to try to control many entities, under stress and in a rapidly changing environment, may depend on what level of control is intended.

If a lesser degree of control than that of the traditional command relationship is exercised, that is, if only a single task such as target assignment is attempted, it seems entirely possible to exercise a much greater span of such limited control via a combat network than the traditional span of control associated with command. This, in fact, is the way artillery fires are massed: targets are assigned by a central fire control element, but individual unit commanders command the firing units. This scheme extends that to all units rather than just artillery and mortars. A great amount of information is available to a person in a modern network centric formation to allow targeting decisions; the same network will allow instructions ranging from a set of target map coordinates to actual aiming commands to the ballistic computer to be transmitted rapidly to the actual engagement platform.

Given that it is technically practical to adopt some form of location-based control of fires, how does this differ from present practice and what problems must be addressed in implementing it?

3. Proximity-Based Fires Concept vs. Present Doctrine

Present control of direct fires is by the platform or unit commander. Control of observed indirect fires is by the Fire Direction Officer (FDO) in the Fire Direction Center (FDC). There is an FDC at battery and artillery battalion level, and one may be established at platoon level if needed. The battery or platoon FDC can receive calls for fire from observers or fire missions from the battalion FDC. When the battery is operating under control of the parent battalion, the requests for fire go from the forward observer or other fire control team to the battalion, FDC. The battery FDC will conduct technical fire direction while the battalion FDC conducts tactical fire direction. The battalion FDO in that case assigns the mission to an asset and the mission is sent to the chosen battery or batteries FDC for computation of the firing solution and execution (*1*). The firing unit will fire across tactical unit boundaries as required. It supports an area defined by the area of responsibility of the supported units.

The proposed scheme of allocation of fires from all assets from any unit within an area, by their proximity and ability to engage the target, is not so very different from the present scheme of indirect-fire support. The difference is the use of additional assets not usually considered suitable for use in indirect fire. It is worth remembering the use of the 75-mm gun in the M4

Sherman in WWII and Korea as artillery, though that was driven more by logistic necessity than tactical optimization. In the proximity-based fires concept, the fires from anything physically capable of reaching the target, less those assets made unable to join the fire mission by tactical necessity, would be available to engage a target. These assets may in fact have considerable advantages in some unconventional instances compared to the usual employment methods. There are practical limits to this use imposed by tactical realities and some technical possibilities that could increase the power of such a paradigm.

4. Fire Central

One question is, who will be "Fire Central?" The Unit of Action Brigade will have a fires and effects cell (*2*). This cell will get the targeting and sensing information necessary to allocate targets. An expansion of its role to include fires from anything that is available to do the job seems natural. The details or protocols on what can be requested or simply controlled and used will have to be settled very carefully.

If Fire Central is able to access assets across unit and branch boundaries, one issue might be how the assets are allocated to a given target. The assets may be allocated by the Fire Support Officer based on location, perceived tactical needs, ammunition load, or other factors. This is an old problem and there have been numerous solutions, one of which, fire control by negotiation, is tailor made to allocating fire missions between widely spaced elements. It is a solution to "stove-piped" fire support, having been developed for artillery assets alone, but it may be useful in this context as well. Fire control by negotiation was demonstrated as part of the Smart Weapons System Laboratory Command Cooperative Demonstration, 25–29 September 1989 (*3*). It is nicely summarized:

"Paladins were expected to roam the battlefield in autonomous pairs, and the goal was to minimize communications. The technique was called 'fire control by negotiation." When targets were detected, the sensings were forwarded to a central FDO (Fire Direction Officer) who prioritized them and for each valid target, a request for fire was broadcast to all shooters. Each shooter returned a bid reflecting its ability to engage the target. The FDO returned orders to a sufficient number of 'high bid' shooters to neutralize the target. The entire process then repeated with the next target. The entire process was invisible to the crews except, of course, the firing orders. We never worried too much about how the bid was actually computed" (*4*).

Computation of the bid could be done in several ways, each tailored to the situation. For instance, if resupply were problematic, ammunition supply could be the paramount factor. Proximity to enemy forces might be paramount in other situations. A mobility failure might bring a platform to a high position as a bidder, pending arrival of a contact team or other assets to

restore mobility. Other weighting factors might apply. This is a very neat way of matching shooters to missions and would probably work very well for a force organized along the proximity-based fires concept as well as a more or less conventional artillery force.

5. Future Combat

Future combat is described in TRADOC PAM 525-66 (*5*). The scheme for allocation of fires described in this report matches the outline of future combat described in the pamphlet very well. The future network described will permit the targeting of elements within the area of responsibility for such a "fire central," and the engagement capabilities of the future systems will permit attack. The beyond-line-of-sight (BLOS) capabilities envisaged for platforms will be especially valuable. The extended range and capability to hit and destroy targets in defilade will mean that every properly equipped platform for up to 10–12 km from a target can engage it (*5*). Interestingly, the vision of future combat uses terms such as "combat maneuver system" for the system required to have LOS and BLOS capability (*5*). Whatever serves as a capital weapon in lieu of the present conceptual role of the tank may be a powerful entity indeed. If every one of those for a circle 20–24 km in diameter can engage a target area, the targets in that area will be in severe danger. Further, active defenses such as ARENA (*6*), or its first generation cousin, DROZD (*7*), may be more easily countered by saturation or by simultaneous attack from differing, multiple azimuths.[*]

Although the main thrust of this concept is engagement of ground targets, particularly area targets, maneuvering targets might be engaged if communications latency can be reduced sufficiently. One interesting possibility might be following a maneuvering aerial target with automatic cannon fire from a sequence of platforms, each platform engaging in turn as the target unmasks. There are obvious difficulties in fire control cued, directed, or even slaved from a central computer, but the idea also seems not far from the ideas of the architects of future combat:

"…[The Unit of Action] must gain improved early warning from [Theatre Anti- Missile Defense (TAMS)] …sources, and have the ability to intercept enemy air threats, primarily helicopters and UAVs, in multifunctional, all-arms approach" (*5*). "….The UA's networked, integrated approach to counterair will enable all FCS platforms to receive early warning, and conduct self-defense counterair engagements against low and slow moving portions of the rotary wing and [Unmanned Aerial Vehicle (UAV)]… threat. Selected platforms will be equipped to defeat

[*] It might also be noted that this ability to fight from defilade may require rethink of just what "dominant ground" is. If enemy surveillance can be countered passively (smoke) or actively (optical and radio-frequency jamming), one may wish to let an enemy take the high ground, mask or destroy their sensors, and pound them to death there with everything that can hit them.

rotary wing and UAVs at longer range. The UA will depend on the U.S. Air Force to defeat the fixed wing threat…" (*5*).

If the platforms are equipped with autotrackers (very old technology now), ranging devices (now even being installed on Bradley infantry fighting vehicles [IFVs], though the data rate must be improved substantially to engage a fast mover), and a decent computer (very cheap in hardware costs), perhaps even fast movers that get low enough to engage might be in peril. Network latency must always be kept in mind when contemplating such tasks, however; this is discussed as follows.

6. Commander's Veto

The commander has to have primary control of his assets. Availability of those assets to a central fire control (Fire Central) has to be negotiated in some way around that requirement. There are several cases that come to mind when a central fire control should not be able to take control of a unit's assets.

- Cover and concealment: when the assets are in a covered and concealed position, the firing signature could betray a unit's position and lead to targeting of the platform by enemy weapons or betrayal of an ambush position.
- Ammunition shortage: the platform may be critically short of munitions, and expenditure of munitions may leave it dangerously vulnerable to an expected assault.
- Critical timelines: the platform may be in imminent danger of enemy direct fire and any time delay in engaging an enemy preemptively or reactively may lead to loss of the platform and its crew.
- Movement: if firing must be from a halt the platform may be tactically unable to stop. This could even be due to safety considerations; having your tank suddenly come to a halt could be very bad if one is in a column that is moving.
- Terrain: this paradigm may be greatly restricted in built-up areas due to restriction of the shot line. Simply put, one may not be able to fire on anything beyond the first row of buildings around the firing unit. IFV automatic cannon can loft their projectiles at a very high angle, but flatter trajectories may be blocked. This will vary; in a shantytown the blocking may be minimal due simply to the near absence of anything tall. In areas with multistory buildings, this may well be a serious factor.

There are surely other conditions, which the doctrinal theorists will surface. Basically, the commander must be able to set the conditions under which a central fire control may be able to use the asset without compromising the mission or endangering the crew needlessly.

7. Enabling Technology

7.1 General

Technological factors are by far the easiest to address. The factors include information transport, decision and control tools, and the technical characteristics of the various weapon systems.

It is almost taken for granted now, but the information transport by the packet network is the key enabling technology. This network, mostly radio based, includes what is usually called the "tactical internet." This network means that information is easy to share outside a unit radio net—the information goes to a destination based on its IP address, rather than the membership of the destination in a specific radio network as defined by a frequency or a frequency hopset.

A problem with current practice, which will ultimately be resolved, is message latency. Messages at the present time are delayed somewhat due to the limited bandwidth of tactical radios, especially in the forward areas. Except in matters relating to real time control, this seldom poses a problem. In the case of a Fire Central slaving a tube on a platform to engage a moving target based on data from a remote sensor, this could prove unworkable. If Fire Central cued the platform and the platform then engaged the target with its own sensors the scheme might work, providing message latency were not too great. If engaging stationary or slow moving ground targets, latency should not pose a problem unless the net were on the edge of complete breakdown.

Decision and control is a central problem, but a tool may already exist. Basically, a tool must accept sensor information, store battle planning material, and accept battle status information from the combat computer net. Presently, this combat computer net is the Maneuver Control System. Three-dimensional terrain data and aerial/satellite recon imagery is also required. Three-dimensional perspective terrain rendering, especially with terrain imagery "painted" on may be crucial. The tool developed by the U.S. Army Armament Research, Development, and Engineering Center, which can do all of this, is the Combat Decision Aid System.

The proximity-based fire concept can use just about every weapon system except rifles and dismounted support machine guns. If the Army progresses with concepts such as Land Warrior, even those may be usable in concert with cues from Fire Central. Artillery weapons will fit in nicely to the expanded scheme much as they are. Other, developmental systems, such as Netfire, will be directly usable. The net-centric Future Combat System fits seamlessly into this expanded

picture as well. Platform mounted systems include IFVs, both Bradley and the lighter weight successors, and tanks. With modest enhancements, all can serve as indirect-fire platforms.

The range of capabilities depends on the range of fire control enhancements. There are several conceptual levels of fire control ranging from use of systems in their current configuration to something like the M109A6 Paladin self-propelled artillery piece. Paladin has precise navigation through track motion from a known point, azimuth and elevation tachometers (sensing), a north-seeking gyro, and a nice fire control computer. The computer can even lay the tube and fire the cannon, automatically, or the gun can be laid manually. The Paladin does not have a pitch/yaw sensor, however (*8*).

7.2 Infantry Fighting Vehicles

Regardless of weight, the future IFV will be able to engage with light automatic cannon fire, machine gun fire, and missiles. The capability of the present systems are so valuable because of their firepower; it is difficult to imagine future commanders being willing to consider less capability than the present family of fighting vehicles. Although machine guns were used in an indirect-fire mode in WWI, this is unlikely to be a viable course in future wars.[*] Automatic cannon fire will be limited by the onboard ammunition load, fuzing, and geometrical factors such as maximum elevation angle, but for a brief period a company of IFVs could put quite a bit of metal into a selected area, if the fire control requirements were met. For fires against a visible target area this would pose little problem. Fire control requirements for indirect fires would include sensors and readouts for platform location and orientation (yaw and pitch, and true north) and tube orientation. A flexible fire control computer is required also, both to generate a fire solution onboard and to implement a solution sent from a central control center.

The Bradley 25-mm cannon can fire at high angles, up to ~60° (*9*). The rounds can therefore be made to drop at a steep angle. This could be invaluable in built-up areas. The small, nominally 5-m lethal bursting radius might be very useful in reducing collateral damage and casualties.

However, the M792 high-explosive incendiary (HEI)-tracer round, with the M758 fuze, has a self-destruct function based on time of flight. In normal (lower angle) trajectories this amounts to ~3000 m, which could limit use of the high angle option since the time setting on the fuze is a built-in mechanical option.[†] This could be altered in production or the fuze replaced with an electronic variant with a proximity function and the somewhat bulky springs and rotors replaced by micromachined devices.[‡] Dispersion of the rounds at high angles of fire, not to mention wind

[*] Personal communication, Louis Meador, formerly Sergeant, Infantry, USA Expeditionary Force (1917–18), to Brand, uncertain date. In WWI support machine guns were water-jacketed, the area of employment was both fixed in location and limited in extent, and huge supplies of ammunition were routinely available and as routinely expended. Although SGT Meador's machine gun support company could and did generate a substantial beaten zone, and keep it beaten for quite a while, it is not likely to be doable now, except under exceptional conditions. Mr. Drake has also mentioned this past usage.

[†] FM 23-1, paragraph 1–8c, stated max range for M792HEI-T is 3000 m, at which it self-destructs, p 1–16.

[‡] Electric initiation might make duds less hazardous for our troops and for civilians after the battle has moved on.

drift,[*] may be substantial and may also limit use of this option, but the dispersion may be less than for other systems. High angles of fire with spin stabilized rounds involve a substantial angle of attack for the round; a cannon that fired nearly vertically would have the rounds flying backwards in the downward part of the trajectory. A beaten zone from nearly vertical fire might be nearby but might well be substantial in size and even pose a danger to the firing platform. Fuzing might be problematical as well. Fin-stabilized munitions such as mortar bombs are of course not affected this way.

The small lethal bursting radius of light automatic cannon rounds would help reduce the demolition effect inherent in larger blast-fragmentation rounds, such as unitary artillery and mortar rounds, and area denial could perhaps be exercised without as many civilian casualties as would result from larger blast-fragmentation rounds or large bomblet rounds. Certainly a series of small blast-fragmentation rounds impacting in a street would reduce enemy use of that street, say for moving reinforcements to respond to a U.S. attack. Larger blast weapons such as unitary shell from heavy mortars or artillery could also add significantly to rubble, hindering later U.S. movement through the area, providing hiding places for enemy soldiers, and reducing fields of fire. The incendiary effect of an HEI round could be extremely dangerous in an area based on wooden construction, but that would also be true for use of the round in ordinary low angle of fire antitank crew and sniper suppression. For that matter, it may be desirable to set a single building on fire to drive out defenders without incinerating several hectares, and a series of such rounds on the roof could certainly help apply force in a more limited way than other options.

It should be noted that bomblet dispersion of 155-mm artillery cargo rounds is of the order of 10,000 m^2.[†] The light cannon may well have a more localized effect, more suitable for urban fighting. Mortars would be in many or perhaps most cases superior, but may also be occupied elsewhere, and are considerably less numerous than the automatic cannon on the IFVs.

7.3 Tanks

7.3.1 Ammunition

A tank platoon has a potential firepower comparable to a Navy destroyer. The present 120-mm cannon is an immensely capable system, and the eventual fielding of the 120-mm medium range munition (MRM), with its indirect-fire capability against point targets, will fit into a new fire

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[*] Thanks to Mr. Drake for pointing out wind drift problems.

[†] "A salvo of six Ogre shells releases 378 bomblets to saturate an area of three hectares at a range of 35 km." From http://www.army-technology.com/projects/caesar/ and http://www.giat-industries.fr/asp/us/pdf/us_ftech_ogre.pdf, for the French 155-mm round. If you want less than a couple of hectares or so blasted, you may be out of luck with bomblet artillery rounds.

control scheme very well. The cannon in U.S. service does not at this time have a blast-fragmentation or cargo round; the 120-mm M830A1 high-explosive antitank (HEAT)-multipurpose (MP)* round (see figure 1) is presently used for that purpose, but Rheinmetall has in fact developed a 120-mm HE MP round for the Leopard 2 (*11*). From this to a proximity fuze and a cargo variant is a small step. The M830A1 has a dual mode fuze, which can function as a proximity fuze to increase effectiveness against soft or aerial targets. The M830A1 has a cousin, the XM908 HE-obstacle reducing (OR)-T (120 mm). The OR round does not have an airburst capability.

An interesting round that could contribute substantially to repulse of massed infantry is the 105-mm antipersonnel/ antimateriel (*12*). In the top attack mode the six individually fuzed submunitions, each with 500 tungsten cubes, would have a terrific effect on infantry in the open. It is a higher technology reprise of the traditional shrapnel round developed so long ago.

In the Third World, conventional HE tank ammunition is now made and sold.† There do not seem to be any particular obstacles to U.S. use of similar assets. It should be noted indirect fire from tanks is still contemplated elsewhere; the T-62 has a gunner's quadrant "fitted as standard," with a listed indirect-fire range of 9400 m. This vehicle has an HE-FRAG round; the stated ammunition load is 21 HE-FRAG-FS rounds out of 39 rounds carried (*13*). The T-54 also has a maximum range given for indirect fire with the D-10T 100-mm rifle of 14,600 m and is listed as having six models of HE-FRAG round available (*13*). Inclusion of a gunner's quadrant in the tank's kit is not mentioned but may be assumed.

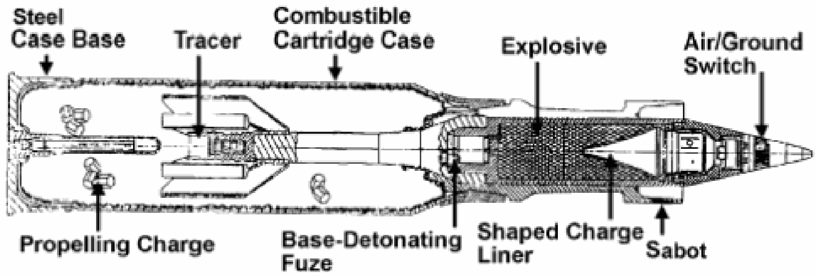
7.3.2 Navigation and Orientation

For effective indirect-fire control the firing platform must be level or able to compensate for trunnion cant, must be accurately located, and able to orient with respect to or sense true north. The Abrams fleet has much or all of this capability, depending on the model.

All models of the Abrams series have a trunnion cant sensor; hull pitch and yaw sensing would be easily implemented. The turret could in fact be traversed and the varying trunnion cant readings would define hull pitch and yaw, if hull mounted sensors were not implemented. Another possibility is use of differential GPS installations to define pitch and yaw, but the practical precision of such measurements is not clear. Crews of the Abrams and the Bradley Fighting Vehicles have handheld GPS available, and some models have both onboard navigation/orientation systems and north-sensing sensors. The difference in capability is striking. The M1A2 has the position/navigation (POS/NAV) system, a navigation system that computes location and heading of the hull based on initialization at a known point and along a

*Short descriptions of the MRM and M830 HEAT-MP are given in reference (*10*).

†for instance, the Turkish Mod 233 105 mm HE (http://katalog.ssm.gov.tr/english/2450e.htm), and the Pakistani 105-mm HE TK P1 A1 and 125-mm HE (no model number provided) (http://pofwah.com.pk/tk_123.htm and http://pofwah.com.pk /tk1234.htm).



Muzzle Velocity:	1,410 m/s.
Announced in fire command as:	"MPAT" (ground mode). "MPAT AIR" (air mode).
Fuze:	Point-initiating, base-detonating (ground mode). Proximity or point-initiating, base-detonating (air mode).
Employment:	**MPAT GROUND:** Light-armored vehicles, buildings, bunkers, ATGM platforms, and personnel. Secondary round for tanks or tank-like targets. **MPAT AIR:** Helicopters.
Projectile Color Code:	Black with yellow letters.
Weight:	50.1 lbs.
Length:	38.7 in.
Storage Temperature Limits:	-50°F to 145°F
Safe-to-Fire Temperature Limits:	-25°F to 120°F
Performance Temperature Limits:	-25°F to 120°F

WARNING

The nose of the M830A1 contains the air/ground sensor. This sensor can be damaged if it is struck on hard surfaces inside the turret (turret strut, breech, etc.) with moderate force. Loaders must take precaution to avoid striking the nose during the loading process.

Figure 4-11. M830A1 HEAT-MP-T (120-mm).

Figure 1. The M830A1 multipurpose round (*14*).

known azimuth. The uncertainty increases as the vehicle drives, due to track slippage. Location is easily updated with GPS, using the portable lightweight GPS receiver (PLGR).*

*Depending on the context, GPS can refer to the M1 family Gunner's Primary Sight or to the Global Positioning System.

There are serious opportunities for tired and frightened crew to make mistakes in setting up or initializing or updating the navigation systems, plus the necessity in the M1 series vehicles with POS/NAV, for commanders to manually take into account the difference between the turret orientation with respect to the hull and hence grid north using the compass heading indicator and the turret/hull reference indicator (*15*). These integration tasks would be technically trivial but bureaucratically and programmatically difficult to do.

Firing point and target location options for several models of M1 and M2 Bradley Fighting Vehicles are listed in table 1.

Table 1. Navigation options in the Abrams family, the M2A2 family of the Bradley Fighting Vehicle, and M901 Fire Support Team Vehicle (FIST-V) (*16*).

Vehicle	X, Y Location	Altitude	Trunnion Cant	Heading From	Updates
M1A1	Handheld PLGR, lase known point	Map	Cant sensor	Map, PLGR	—
M1A1D	PLGR, lase known point	Map	Cant sensor	NSG	—
M1A2	POS/NAV, PLGR, lase known point	Map	Cant sensor	POS/NAV	PLGR or lase known point, allow for track slippage
M1A2SEP	POS/NAV	Map	Cant sensor	POS/NAV	PLGR integrated
M2A2	PLGR	Map	—	Map, PLGR	—
M2A2ODS	PLGR, lase known point (POS/NAV?)	Map	—	Digital compass system (DCS)	—
FISTV	Targeting Station Control Display (TSCD)	Map	—	NSG	Initialize to 10-digit grid with altitude

7.3.3 Computation

Fire control computation should be straightforward. Firing solutions should be simple to implement whether computed on platform from target coordinates or computed off platform and sent for implementation by the onboard computer. Other issues, such as override, are simple in concept but must be carefully thought out. For instance, it seems reasonable for the vehicle commander to be able to override a firing order. For fleeting or moving targets an automatic engagement option may be needed. Such an option could be extremely dangerous to the crew and others in the unit if not implemented carefully. On the other hand, following a moving target along its flight path until it is destroyed also has its own attractiveness.

7.4 Data Flow

Target sensing data is presently distributed in the company via the Inter Vehicular Information System; this can be directed to the Fire Central as well. The low present data rates may preclude actual control of the weapon from a central location, but this should be addressed with the next generation of tactical radios. Use of onboard visionics to correct the tracking solution

is eminently possible, though the potential for truly horrific accidents from false target acquisition by auto-targeting algorithms requires the capability for crew override and possibly the requirement for crew concurrence before shots are actually fired.

8. Risk, Cost, and Performance Level

One may define four levels of performance as a conceptual tool to assess risk and cost. These may be assessed as level 1, the use of present capabilities, to level 4, a capability up to full remote control from Fire Central.

8.1 Level 1: Use What We Have

Direct fire, LOS only:

- Fire Central sends target location, or possibly a vector to the target, to designated firing units.
- Designated firing units acquire targets and compute firing solutions.
- Multiple firing platforms engage with existing munitions.
- If firing asset cannot break cover or is otherwise engaged, commander vetoes use.

Benefits:

- Simplest way to increase available fires.

Challenges:

- Individual units may expend more munitions than planned.
- For platforms without a north-seeking gyro or POS/NAV, true north must be determined from map study and landmarks or by a procedural workaround, perhaps on the buddy system using GPS.

8.2 Level 2: Enhancements

Direct and indirect fire:

- Fire Central sends target location, possibly vector to target or firing solution, to designated firing units.
- Designated firing units compute firing solutions and/or lay guns.
- Engage with existing munitions.
- If firing asset cannot break cover or is otherwise engaged, commander vetoes use.

Benefits:

- Relatively simple to implement (yes, it's a matter of opinion).

Challenges:

- Requires north-sensing device on vehicle, upgrade to ballistic computer. The M1A1D has a north-seeking gyro and the A2 and A2 SEP have the POS/NAV system. Procedural workarounds for true north and platform pitch/yaw may be adequate.
- Gun elevation limit imposes a fundamental restriction in range and in terrain covered (angle of fall).
- Need automatic turret orientation information. The M1 series has an elevation tachometer. The cant sensor may do for platform pitch and yaw with a turret rotation. The M1A1D has a north-seeking gyro and the M1A2 and A2SEP have the POS/NAV system for estimating hull orientation, though it may not be accurate enough for gun laying. The tank commander has a readout for turret orientation with respect to the hull in all models of the M1 family, so the information is available in some models and only needs integration.

8.3 Level 3: M109A6-Like Capability

Direct fire and indirect fire:

- Fire Central sends target coordinates to designated firing unit.
- Firing unit computes solution and fires mission.

Benefits:

- Self-contained and flexible.

Challenges:

- Requires M109A6-like fire control system capability. Not technically insurmountable, but will cost. The M1A1D is close to that already.
- Easiest—fire control computer gives readout for manual laying of gun.
- Harder—onboard computer lays gun using tie-in to turret drives.

8.4 Level 4: Full Remote Capability

Remote control capability from Fire Central:

- Fire Central computes solution and lays gun remotely.
- Automatic on-platform target acquisition could be used for fine aiming where LOS exists.

Benefit:

- High speed could be used to engage moving or fleeting targets acquired by sensor net.

Challenges:

- Not technically insurmountable, but would really cost.
- Comms latency may be a problem.
- Soldier acceptance would likely be a problem until technology has a long and spotless track record.

9. Combat Power and Lanchester

The Lanchester methodology allows an estimate of the increase in combat power that might result from this scheme. There are several "Lanchester Laws" that may apply.

The development of the expression referred to as the "Lanchester Square Law" includes assumptions. The "Square Law" relates combat power to the numbers of combatants, squared. That is, the ratio of combat power, all else being equal, for sides with numbers of combatants m and n is m^2/n^2. Two forces of, say, 15 units and 10 units have relative combat powers of 225 to 100 or 2.25 to 1 rather than 1.5 to 1. The condition is expressed as "If, again, we assume equal fighting value and the combatants otherwise [are] on terms of equality, each man will in a given time score, on an average, a certain number of hits that are effective" (*17*). One aspect of the assumption is a degree of mutual accessibility. That is, each unit on a side must be able to continually have a serviceable target, which implies being able to potentially detect and service several targets, not just one.

In practical terms this means that a unit must have several enemy units accessible for engagement. If this assumption breaks down the exponent is <2. Lanchester discusses the limit of this case, where one combatant opposes one enemy: linear tactics with edged weapons. In that case, the exponent is one.

For a force operating under the proximity-based fires paradigm, the assumption of accessibility will clearly be more nearly true than for one that does not. The resulting ratio of combat power should be correspondingly disproportionate. For instance, a force of m units with accessibility to many of the n opposing units, with each of the n units only able to engage the unit before it, could well have a combat power ratio of m^2/n.

Alternatively, consider a three unit blue force that is able to concentrate all its fires upon a single target set. Assume the blue and enemy forces are of equal strength. If the blue force is opposed by a three unit force of equal size, each of whose units can only oppose the force in front of it,

and if the blue force is able to interrupt the cohesion of the enemy long enough to concentrate its fires upon one unit and smash it then turn to the others, the blue force can defeat the enemy force in detail by fire, rather than by maneuver, with a combat advantage 9 to 1 in each engagement.

Action of this nature may be so fast that it could be accomplished inside the enemy's decision cycle, so that interference with their command and control may not even be necessary.

Restriction of the enemy engagement parameters could be accomplished by interruption of communications through jamming, high-power microwave bombs or projectiles, conventional force, information warfare techniques, smoke, or perhaps other means such as optical jammers. This may be a means of partially redressing the disparity in combat power in a "Yalu/Pusan Scenario" described later.

10. Scenarios

10.1 Conditions

We have just fought several wars without need for the extra firepower capability, and extra complications, outlined here. Under what sort of scenario might we need it? This scheme would be most useful in fighting a true military peer or when locally grossly outnumbered. The probability is great that in future combat we will at least initially be heavily outnumbered and the artillery might be fully committed, not least in countering a much larger enemy artillery force. Suppose we look at replays of past wars. Two scenarios based on actual combat come to mind: Pusan Perimeter II and Yalu River II.[*] A third scenario is based on the entry phase of an intervention in an area without significant resident U.S. forces: Task Force Smith II.

The Battle at the Pusan Perimeter was the result of several concurrent factors, including total surprise by the North Koreans, lack of forces in theater, poor training and supply of both U.S. and South Korean forces, and inadequate air and naval fire support due to low force levels. Other factors such as planning and doctrine may be addressed as well. The result was the outnumbered Allied forces being pushed back to the port of Pusan, in a desperate defense, while other forces were redeployed to the theater and other forces mobilized. It may be worth considering that the U.S. Army in 1950 was organized into ten divisions, with 670,000 active duty soldiers at the beginning of 1950 (*18*). The authorized active duty strength of the U.S. Army as of this writing is 512,400 active duty soldiers and 148,442 mobilized reserve soldiers,

[*] In the winter of 1950, over 300,000 Red Chinese crossed the Yalu River, the border between North Korea and China, and threw the UN forces back to near the present DMZ. See http://www.time.com/time/asia/magazine/99/0927/ yalu_river.html and Field, J. A., Jr. History of Naval Operations: Korea; Chapter 9: Retreat to the South. http://www.history.navy.mil/books/ field/ch9b.htm (accessed 14 September 2005), among many others. This was a superb and presently neglected example of what is now called asymmetric warfare. The Pusan Perimeter was the foothold on the Korean Peninsula that the UN forces established around the southern port of Pusan, after the U.S. and the world were taken by surprise by the initial North Korean onslaught.

organized into 10 divisions (*19*). A Pusan-like scenario is not at all likely right now, but perhaps not unthinkable, either.

Task Force Smith is famous for being thrown into battle untrained, ill-equipped, and without either logistic or intelligence support. This level of ill preparedness is unlikely to be repeated any time soon. However, the basic catastrophic defeat was due more to being grossly outnumbered and inserted into an indefensible position. That may well happen any time, even to the best led, best supported forces.

The Yalu River debacle was the result of among other things, faulty intelligence, poor training of U.S. forces, the U.S. forces being allowed to be caught in an indefensible tactical posture due to the poor organization of the pursuit of the retreating North Koreans, and a host of other factors as well. Again, the most important factor seems to have been the massive intelligence failure concerning not just Red Chinese intentions, but their actual deployment inside North Korea of several hundred thousand men. Whether such an intelligence failure is likely or even possible now, given modern surveillance systems, is a matter of opinion, but it might be borne in mind that the successful Iraqi invasion of Kuwait was done in an era of satellite and high altitude aerial surveillance.

Task Force Smith II did not happen in the first Gulf War, but was a matter of intense concern at the time. There was widespread speculation that if the Iraqi forces, after occupying Kuwait, had continued on to "bounce" Saudi Arabia during the entry and buildup phase of the first Gulf War, U.S. light forces securing ports of entry might have been confronted with large numbers of heavy forces. The U.S. forces in 1990 were incomparably better equipped, trained, and led than in 1950, but it would have been a very difficult situation at best.

An excerpt from a narrative of battle from any of these situations might look very similar. How might those come to pass? If an expeditionary force were committed to battle in a remote area with difficult logistics, and a neighboring power with a large conventional force were committed suddenly, we could easily have a reprise of the debacle on the Yalu River or the desperate defense, vastly outnumbered, of Pusan. A much worse possibility is Task Force Smith.

All three of these past crises, especially the defeat on the Yalu, were due to surprise; the surprise was due to a failure of intelligence at the strategic and operational levels. The national command authorities did not see it coming (strategic) and neither did the theater commander and his staff (operational).

Interestingly, in the case of the Yalu intervention, the theater was well aware of the threat, and had specifically directed that info on Chinese involvement be collected, and there were in fact several encounters with captured Chinese soldiers, but somehow this did not register on the theater commander and his staff. As the great S. L. A. Marshall said of the Chinese, "…they matured their battle plan and became victors…because they had a decisive superiority in information" (*20*).

If we were committed suddenly to establish a foothold in a hostile area, and if, through special operations the U.S. maritime propositioned assets were destroyed or used up by concurrent obligations (two war scenario), and if fixed wing air support were hindered or negated by political, special operational, or technological means, we might find ourselves defending at terrible odds and at a great firepower disadvantage. Up to now we have been able to count on the Navy and Air Force, but they require nearby air bases and carrier battle groups to keep forces on station at adequate levels. The alternative is very long flights to the battle, with aerial refueling, resulting in low on station utilization rates.

The Navy requires an environment where carriers can approach the coast. The proliferation of long range antiship cruise missiles and quiet diesel submarines in the Third World may render such support difficult and uncertain. For example, suppose an enemy were to, as part of an invasion of Taiwan, establish lodgments along the eastern coast and emplace long range shipkillers and antiaircraft missiles. The antiship missiles, with forward antiaircraft missiles and interceptors, acting in concert with a large, and to Third World rulers, expendable submarine force, might create a force that would be difficult and time consuming to fight through. Air support and even resupply and reinforcement might be difficult.

Under those conditions the fire power of the total expeditionary force on the ground should be available to destroy the enemy at any point in the battle, regardless of branch affiliation, or we might be overrun one piece at a time, as we were at the Yalu.

To examine this proposition, let us consider an imaginary battle somewhere in Asia, sometime in the future, patterned after these former battles.

10.2 Yalu II/Pusan II/Task Force Smith II

Consider a narrative of a fictional situation. The setting could be nearly anywhere in the world where the network of friendly staging and logistic support bases are few and distant or neutralized diplomatically, perhaps under threat of nuclear terrorism or under state-directed nuclear blackmail. Doctrine does not support this narrative, as successful implementation of overwhelming power by a joint force is doctrinally assumed. If the enemy can successfully break that paradigm, then the enemy goal of asymmetric warfare may be gained, with U.S. forces on the weak end of the asymmetry. This speculative narrative is similar to the three past cases cited previously, only in this narrative there is a happy ending.

The enemy forces pour through the gap broken in the Allied Republic lines, spreading out into the rolling ground along the river. The U.S. Expeditionary Force, air landed and entrenched west of the small town and its airstrip, prepares to receive them. The U.S. is thin on the ground. The enemy has a modern armor battalion among the numerous but lightly armed infantry. The rest of the enemy armor has been destroyed with smart munitions seeded over the enemy debarkation and assembly areas by the few U.S. heavy bombers able to reach the battle in time.

Fire Central, the central area fire control node in the Force command net, receives imagery from orbit and from drones above the assaulting enemy forces. Information from the acoustic and video snoops seeded the night before confirm the aerial recon imagery. The leading edge of the enemy assault is sweeping around the low hills. The Force artillery fires into the gap, slowing and disorganizing the enemy, but the US fighter-bombers are no longer a factor due to missiles and the long flight time from distant bases. Strikes from stealth bombers are ineffective against a force thinly spread out, devastatingly effective within a small area, but not dense enough to seriously hurt the enemy. The enemy's logistic structure has been destroyed in a series of stealth bomber strikes, but the effects will only show over days, and if the enemy can destroy the U.S. forces on the ground now, the effects will be small.

The first edges of the assault encounter the outer layer of fighting positions. The defense is built as a series of hedgehogs with the intervening ground covered by fire; no continuous line is possible with the forces available. The tube artillery shifts from the gap and begins to engage the enemy troops in front of the first defensive positions. Rocket artillery continues to engage the gap. The hedgehogs begin to decimate the enemy troops before them with direct projectile and missile fire. Then the enemy infantry assault reaches more positions. No more artillery is available; Fire Central directs the heavy tubes of the unengaged weapons carriers into indirect mode. Slaved to Fire Central, 96 heavy tubes begin delivering low-velocity, high-capacity bomblet rounds at the enemy forces stalled before the Allied positions.

Suddenly, the first platoon of enemy armor emerges from the chaotic sensor picture. Fire Central switches a weapons carrier company to indirect-fire precision seeker rounds and destroys the enemy armor. The next enemy armored units sweep around the destroyed vehicles of the lead platoon, seeking to close before being destroyed. As each comes into the sensor picture a heavy volume of precision fire is directed on them, while the artillery continues to engage the assaulting infantry.

The sensors begin to discern the armored command caravan of the enemy commander. Fire Central switches an artillery battery to long-range homing projectiles mixed with bomblets. An unengaged company of infantry fighting vehicles receives firing solutions for indirect fire from Fire Central and begins lobbing medium automatic cannon fire into the fire sack in front of the suddenly unsupported hedgehog. The hail of proximity fuzed light rounds detonates at waist level, killing the enemy infantry—who begin to break.

The enemy commander's armored command vehicle is stopped and burning. Individuals began to leave the wrecked vehicles, to be killed or wounded by the fragments from the bomblets. The enemy commander is dead, the chain of command broken in several places. As his defeated force begins to collapse, enemy infantry begins to surrender. In the hedgehogs the fighting vehicles begin the pursuit.

11. Summary

Technology now exists for platforms over a wide area to engage a centrally-directed target, regardless of the unit affiliation. This is in part a return to doctrine of the 1940s to the early 1970s, where tanks were on occasion used as artillery. The doctrine was abandoned due to the length of time required to emplace and survey the vehicles, which would take them from the high-priority armored fight. Technology now is routinely employed on those platforms which makes the formerly lengthy preparation for indirect fire virtually instantaneous. The fire allocation would be centrally assigned and based on proximity to the target, availability of the firing unit, availability of munitions, coordination and integration of available fires, and ballistics: proximity-based integrated fires. This capability is in line with future doctrine and technology and would capitalize on future desired capabilities such as the BLOS systems. This capability will be limited by immediate tactical needs and by the characteristics of equipment not designed for this purpose, but could also be enhanced by modest technical development of existing systems and the fielding of systems already in development, such as the Tank Extended Range Munition.

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